

## **BACKGROUND OF THE INVENTION**

### **FIELD OF THE INVENTION**

**[002]** The present invention relates generally to gas-powered guns and more specifically to guns for firing paintballs.

### **BACKGROUND ART**

**[003]** Guns capable of firing paintballs by use of pressurized gas have been known for a number of years and they are commonly used for recreational sports such as survival or "war" games. The paintballs fired by these guns generally comprise a gelatin shell with a colored liquid or viscous substance in the interior. These paintballs are designed to burst upon impact with a target and thereby create a visible mark on the target.

**[004]** Up until recently the firing mechanisms in paintball guns have generally been mechanical in nature. An example of such a gun is disclosed in U.S. Patent No. 5,349,939 issued September 27, 1994 to Perrone.

**[005]** Recently, electronically operated paintball guns have come into use. One such paintball gun is described in U.S. Patent No. 5,881,707 issued March 16, 1999 to Gardner, Jr. The grip of the gun has an electrical switch capable of activating a launching sequence. An electrical control unit is housed within the body of the gun and a grip and can direct pressurized gas flow between the pneumatic components of the gun in order to load, cock and fire the gun. The electrical control unit includes an electrical power source which activates an electrical timing circuit when the electrical switch is closed and also activates two electrically operated pneumatic flow distribution devices. Upon closure of the switch, the control unit causes a projectile to be loaded

into the launching mechanism by actuation of the first pneumatic flow distribution device. A paintball is fired when the timing circuit actuates the second flow distribution device to release gas from a storage chamber into the launching mechanism.

**[006]** Another electronically activated gun is described in U.S. Patent No. 6,003,504 issued to Rice, et al. on December 21, 1999. This gun employs first and second gas pressure regulators with the first capable of providing high gas pressure in a first chamber of the gun. The second regulator is connected between this first chamber and a second chamber and maintains a lower working pressure in the second chamber. A control valve receives gas under pressure from the second chamber and directs it selectively to a ram slidably mounted in a cylinder. The ram is moved by gas pressure between a retracted position and a forward position where it opens a valve to allow high pressure gas to flow from the first chamber to the barrel to fire a paintball. The gun's trigger operates a microswitch which is part of an electronic control circuit for the gun.

## SUMMARY OF THE INVENTION

**[007]** The present invention comprises an improved electronically controlled pneumatically operated paintball gun having more efficient air usage by means of a pneumatic piston valve with a directional tube vent.

**[008]** This pneumatic piston valve works on direct air pressure to open and close it very quickly. The pneumatic piston valve has one moving part called the "piston valve". The piston valve works as a double acting cylinder. At one end of the piston valve is a seal that presses up against a valve seat. When low pressure air is applied to the opposite side of the piston valve assembly, the force created from air pressure forces the piston seal against the valve seat, closing a high-pressure chamber. When low pressure air is allowed to be released, force created by air pressure shifts the valve and forces the seal away from the valve seat. When the valve is opened, air is released from the high pressure chamber into a directional tube positioned directly behind the paintball, forcing the air to travel in a straight line before the air impacts the paintball. After the ball has been fired, low-pressure air is again transferred back to the original side of the piston, forcing the seal and valve seat closed once again. A pneumatic valve controls the flow of low-pressure air to the piston valve assembly. The time needed to transfer air through the pneumatic valve is completely adjustable through a circuit board.

**[009]** When the piston is inserted into the body of a paintball gun, three air chambers are created. Chamber No. 1 and No. 2 are for low pressure and chamber No. 3 is for high pressure. Chamber No. 1 is located at the rear of the piston valve assembly and is filled with low-pressure air. The low-pressure air creates a force relative to the area of the piston. This force is used to push the piston valve to it's forward most position, forcing a seal (attached to the opposite side of the piston valve) against a valve seat,

sealing off chamber No. 3 filled with air under high pressure. To open chamber No. 3 and release high-pressure air through the valve seat, low-pressure air is switched from chamber No. 1 to chamber No. 2 forcing the piston valve and the seal in the opposite direction and away from the valve seat. This creates a space between the seal and the valve seat allowing high-pressure air from chamber No. 3 to exit the chamber. In an alternative embodiment, movement of the piston valve is controlled using only low pressure chamber No. 1 and chamber No. 2 is kept at ambient pressure throughout the firing cycle. In this embodiment, the piston valve is closed when pressure is applied to chamber No. 1 and is opened when pressure is relieved from chamber No. 1. An advantage of this embodiment is that less air is used for operation of the gun and the shot to shot cycle time is reduced.

## **BRIEF DESCRIPTION OF THE DRAWINGS**

**[010]** The aforementioned objects and advantages of the present invention, as well as additional objects and advantages thereof, will be more fully understood hereinafter as a result of a detailed description of a preferred embodiment when taken in conjunction with the following drawings in which:

**[011]** FIG. 1 is a schematic representation of a paintball gun according to a preferred embodiment of the invention in which a paintball is about to be fired therefrom;

**[012]** FIG. 2 is a schematic representation similar to FIG. 1, but showing the preferred embodiment immediately after a paintball has been fired; and

**[013]** FIG. 3 is a schematic representation similar to FIGs. 1 and 2, but showing the preferred embodiment being loaded with another paintball for firing.

## DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

**[014]** Referring to the accompanying drawings, it will be seen that a paintball gun 10 comprises a body 12 and a handle 14, the former having a compressed gas source connection 15 and a regulator 17 for use with a tank of compressed gas (not shown). A feed mechanism 16 feeds projectiles (i.e., paintballs) 18 into a breech 20 one by one to be propelled at high speed through a barrel 21. A bolt 23 controls the movement of paintballs 18 into the breech 20 and into barrel 21.

**[015]** Operation of paintball gun 10 is by electronically controlled pneumatic valves 33 and 35, including pneumatic propulsion of each projectile 18. Pneumatic propulsion of projectiles is accomplished by means of a piston valve assembly 22 which comprises a piston valve 24, low pressure gas chambers 26 and 28, high pressure gas chamber 30 and valve seat 25. An elongated tube 32, preferably configured as a straight circular cylinder, interconnects the barrel 21 and the high pressure gas chamber 30 depending upon the position of piston valve 24 relative to valve seat 25.

**[016]** The piston valve 24 is moveable between positions represented in FIGs. 1 and 2. In FIG. 1, the piston valve is firmly seated against valve seat 25 thereby closing off chamber 30 from tube 32. In this position, high pressure gas can flow into chamber 30 without being dissipated into the breech 20. This position of piston valve 24 is effected by gas pressure in chamber 26. In FIG. 2, pressure in chamber 26 is relieved which causes piston valve 24 to move away from valve seat 25. Flow of gas at low pressure into chamber 28 may be used to speed up valve 24 movement. This opening of the region between valve seat 25 and piston valve 24 permits sudden release of high pressure gas from chamber 30 through elongated tube 32 into bolt 23 thereby propelling a projectile 18 through barrel 21 at high speed as depicted in FIG. 2. Bolt 23 is then retracted by pneumatic cylinder 19 over tube 32 thereby permitting another

projectile 18 to drop into breech 20 for the next firing. Bolt 23 is then extended to push the paintball into the barrel. Because bolt 23 is a hollow tube which has a diameter that is larger than tube 32, bolt 23 does not obstruct flow of high pressure air into the barrel 21.

**[017]** In FIG. 3, gas pressure in chamber 26 increases, piston valve 24 is returned to its sealing position with the valve 24 again firmly seated against valve seat 25. Pressure in chamber 30 begins to build for the next firing cycle while the next projectile is loaded into breech 20 from feed mechanism 16. The rate of the sequence of events represented in FIGs. 1-3 is controlled electronically.

**[018]** In an alternative embodiment of the invention, pressure in chamber 26 is not changed, but is instead kept at ambient. Closing of piston valve 24 is accomplished by pressurizing chamber 28 as in the first embodiment. However, opening of piston valve 24 is effected by merely draining chamber 28 and allowing the high pressure in chamber 30 to effectively force open the piston valve. This alternative embodiment reduces air usage and reduces shot to shot cycle time by obviating the need to pressurize and drain chamber 26. In effect, piston valve 24 is controlled by only one low pressure control chamber instead of two as in the first embodiment.

**[019]** Having thus disclosed preferred embodiments of the present invention, those having skill in the paintball gun art will now perceive numerous modifications and additions which may be made to the described embodiment. Accordingly, the scope hereof is not to be limited by the version disclosed, but only by the appended claims and their equivalents.

**[020]** I claim: